ACTL4305/5305 Actuarial Data Analytic Applications

Lecture: Ethics

Fei Huang

Reading List

- An Introduction to Statistical Learning (ISLR): Review Chapter 6.1

- The Discriminating (Pricing) Actuary

Learning Objectives

▶ Understand the social and economic principles that can be used to assess the appropriateness of insurance discrimination

▶ Understand prohibitions by line of business and the Australian regulations

▶ Explain strategies for mitigating proxy discrimination

Outline

Introduction

Introduction

- ▶ Discrimination is rampant in society

    - ▶ Think about how you are treated in a store based on your hair colour, skin colour, the clothes you wear, ethnicity/heritage/religion, and so forth

- ▶ Insurance pricing is interesting because the entire industry is based on discrimination.

    - ▶ Here, we use the word "discrimination" in a neutral way

    - ▶ It means the act of differentiating treatment among groups that are characterized by salient features such as hair colour, age, ethnicity, heritage, religion, and so forth.

- ▶ Although many variables are routinely used, the use of others (e.g., ethnicity/heritage/religion) are frowned upon/forbidden

Insurer Actions

How do insurers discriminate among customers?

- ▶ Issuance, renewal, or cancellation

  - ▶ The harshest form of discrimination is the decision on whether or not to issue a policy because of some characteristic.

- ▶ Coverage

  - ▶ Another form of discrimination involves restricting coverage in ways that might harm disadvantaged groups.

  - ▶ For example, insurance companies might limit disability coverage to disabilities for those having a human immunodeficiency virus (HIV).

- ▶ Pricing

  - ▶ Insurance companies discriminate among insureds by simply charging different premiums

  - ▶ For example, an insurer may admit people with various diseases and disabilities to their pool, yet charge these people a higher premium. Is this fair or unfair?

Overview of Insurance Prohibitions

- ▶ Our treatment is based on social and economic **principles**

  - ▶ Consumers are concerned with "unfair" discrimination; we describe social considerations that underpin notions of "fairness."

  - ▶ Insurers also have responsibilities; we describe economic justifications that underpin their positions on "fairness."

- ▶ Actuaries need to understand connections between discrimination concerns and practical (e.g., pricing) aspects

- ▶ Treatment of discrimination is context-dependent; we describe prohibitions that vary by line of business and by jurisdiction.

- ▶ Insurance discrimination has been and continues to be relevant. Considerations of changes due to *Big Data* make it timely.

  - ▶ We discuss issues of proxy (indirect statistical) discrimination that are particularly relevant going forward.

Social Aspects

What is Actuarial Fairness?

- ▶ Insurance aggregates risks into a pool

  - ▶ When first developed, insurance pooling offered a novel method for mitigating the uncertainty of losses.

  - ▶ Before this, the only method of coping with potential loss events was individual prudence.

- ▶ Solidarity

  - ▶ With an insurance pool, losses become the responsibility of the pool.

  - ▶ From a moral perspective, the responsibility for the accident could now be thought of as not attributed to the faulty individual but rather to the collective; in this sense, pooling "socializes responsibility".

  - ▶ Put another way, risk is shared among individuals within risk pools; the premiums of those who are fortunate in the pool and do not suffer the unfavorable events contribute to meet the cost of those who do.

Responsibility and Actuarial Fairness I

- ▶ With the shift of responsibility from the individual to the pool, the sense of fairness shifts and depends upon the nature of the pool.

- ▶ In modern insurance, who takes responsibility for the pool?

    - ▶ **Stock Insurance Company**. The pool is a sum of bilateral contracts that leaves out the collective dimension of insurance.

        - ▶ Actuarially fair pricing is based on the expected value of the uncertain event at stake, taken to be "the risk" transferred from the insured to the insurer.

        - ▶ Fairness means that each customer should pay for their own risk and only their own risk.

    - ▶ **Government**. Subsidies, from one group to another, are common in government (social) insurance. Governments regularly engage in social policy involving the redistribution of risk or income.

    - ▶ **Group Insurance**

    - ▶ **Mutual Company**

    - ▶ **Takaful**

Responsibility and Actuarial Fairness II

- Responsibility depends on the nature of the pool

    - **Stock Insurance Company**
    - **Government**
    - **Group Insurance**. In group insurance, the amount of "socialization" is greater than one would find in the corresponding individual market. Because the plan sponsor typically pays all or a major portion, premiums rated by risk factors are not as relevant.
    - **Mutual Company**. As the owners of the pool are the policyholder themselves, this suggests that the amounts of cross-subsidies among groups or socialization would be greater than in an organization with a for-profit motive. However, in point of practice, mutuals compete with stock companies and so many of their practices are indistinguishable from one another.
    - **Takaful**. Takaful insurance offers, not as a bilateral contract, a transfer of a known risk to a collective enterprize by which Muslims pool resources to aid one other in the event of loss. Responsibility of the loss shifts from the individual to the collective and so aspects of fairness shift.

Insurance as a Social Good

- ▶ Is insurance a social/public good or an economic commodity?
    - ▶ A social good is something that benefits the general public such as clean air, clean water, and literacy.
    - ▶ One characteristic of a public good is that is "non-excludable." Thus, viewing an insurance product as public good would argue against excluding members of society.
    - ▶ When insurance is mandatory or nearly so, it becomes less of an economic commodity and more of a social good.
- ▶ This varies by line of business
    - ▶ In many countries health insurance is likely to be seen as a social good where access to a certain level of healthcare is guaranteed for all.
    - ▶ Life insurance is more often seen as a private (non-public) product, an economic commodity. Life insurance can enhance the financial security of the family of a policyholder but is voluntary and is not viewed as a necessity.
    - ▶ Other insurance lines, such as long-term care and disability insurance arguably fall somewhere in the spectrum between social and economic private.

Characteristics of Sensitive Variables

► Grouping, or classifying, insureds into homogeneous categories for the purposes of risk sharing is at the heart of the insurance function.

► Variables that insurers use can be:

  ► seemingly innocuous (e.g., blindness for auto insurance), yet

  ► others can be viewed as "wrong" (e.g., religious affiliation),

  ► "unfair" (e.g., onset of cancer for health insurance),

  ► at least "sensitive" (e.g., marital status), or perhaps

  ► "mysterious" (AI produced).

Characteristics for Assessing Fairness

What attributes of a variable influence society's assessment of whether it is fair for insurance purposes?

- ▶ **Control.** If an insured has control over an attribute, it is generally deemed to be an acceptable variable to be used for insurance purposes (e.g., your ownership of a sports car)

- ▶ **Mutability**. Does the variable change over time (such as age) or stay fixed?

- ▶ **Causality**. It is generally acceptable to use a variable if it is known to cause an insured event (e.g., cancer in life insurance).

- ▶ **Statistical Discrimination**. A variable must have some predictive value of an underlying risk. A necessary, but not sufficient, condition.

- ▶ **Limiting or Reversing the Effects of Past Discrimination**. Does an insurer's use of a trait perpetuate negative stereotypes, or otherwise subordinate disadvantaged groups? The historical use of the characteristic as a method of discrimination is also relevant; e.g., discriminating based on skin color is more problematic than based on eye color.

- ▶ **Inhibiting Socially Valuable Behavior**. For example, individuals, fearful of being denied life insurance, avoid participating in genetic testing research when insurers make decisions based on genetic test results.

Indirect Discrimination

- Discrimination based on "facially neutral" variables that are related to a prohibited variable

  - The classic example is **redlining**, a term that refers to the practice of drawing red lines on a map to indicate areas that insurers will not serve, areas typically containing high proportions of minorities.

- Indirect discrimination is based on three components:

  - **Proxy discrimination**, also known as *indirect statistical discrimination*, occurs when insurers discriminate based on a facially-neutral characteristic, such as the size of the car engine, that correlates with a protected class, such as gender.

  - **Disparate impact** – whether there is an impact which puts members of a protected group at a disproportionate disadvantage compared with members of a similar group.

  - **Legitimate business necessity** – Example from Khaitan (2018): "A criterion that requires fifteen years of teaching and research experience in physics for a professorship in physics may well affect women disproportionately, who are less likely to have that experience for historical reasons."

Economic Aspects

Economic Considerations

- ▶ For some financial contracts, there is a liquid market with a "law of one price" that is dictated by forces of supply and demand.

  - ▶ Here, issues of discrimination are less important as prices are given by an external marketplace.

- ▶ Insurance pricing is focused on the underlying **cost of producing the good** that many other industries rely upon for pricing.

  - ▶ In part, this is because of the heterogeneity of products

  - ▶ Even in personal insurance (much more homogeneous than commercial), think about the variety of contract features (deductibles, limits, coinsurance, and so forth), risk factors of the entity insured (e.g., auto or home), and risk factors of the insured (e.g., attitude toward risk) that exist.

  - ▶ Another complicating issue is that cost of insurance is random (by definition) and may not be known until several years after contract completion

Adverse Selection by Consumers

- ▶ Potential insurance discrimination is influenced by unequal access to information, known as "information asymmetry."

- ▶ One type is "adverse selection," the problem that arises when consumers know more about their own risk characteristics than insurers.

  - ▶ Insurers argue that by knowing about risk factors the entire marketplace is better.
  - ▶ Indeed, the entire purpose of risk classification is to mitigate the problem of adverse selection.
  - ▶ Extending this line of thought, the more information that insurers have about policyholders, the more effective is risk classification; this in turn results in a better marketplace for all.

- ▶ Another type of adverse selection can occur when an insurer has less information than other competing insurance companies about the risk levels of its customers.

  - ▶ Known as *cream skimming*: the innovative insurer targets the best risks who, like cream in a container of fresh milk, rise to the top of the pool of policyholders.

Classic Adverse Selection Example

- ▶ Two types of consumers:
  - ▶ "Low Risks," who have a 10% chance of having a claim, and
  - ▶ "High Risks," who have a 90% chance of having a claim.
- ▶ With perfect information, the insurance company charges 1 for 10 of insurance coverage to Low Risks and charges 9 for 10 of insurance coverage to High Risks.
- ▶ Without information about the insured risk type, the insurer might split the difference, charging 5. Only High Risks would buy the coverage, leading to eventual insolvency for the insurer.
- ▶ An alternative strategy:
  - ▶ Offer a policy that provides 10 of insurance coverage for a price of 1 but limit purchases to one policy per customer.
  - ▶ Offer a more expensive policy, say 10 of insurance coverage for a price of 9, for any number of purchases.
  - ▶ High Risks would buy this more expensive policy after purchasing the limited policy, whereas Low Risks would only buy the limited policy.
  - ▶ In this way, High Risks get full insurance and Low Risks get some, although not full, insurance.
- ▶ Insurers argue that by knowing about risk factors (in this case, risk type), the entire marketplace is better. Indeed, the entire purpose of risk classification is to mitigate the problem of adverse selection.

Moral Hazard and Incentives

- ▶ Moral hazard – another type of information asymmetry.
- ▶ By purchasing insurance, insureds have the incentive to take on more risks.
  - ▶ For example, if a teen driver is not charged more for driving a high performance car, then there is less incentive to purchase a safer vehicle.
- ▶ *Incentives* are the flip side of moral hazard
  - ▶ Much of modern risk management is predicated on introducing risk mitigation tools to reduce the impact of insured events.
  - ▶ Classic examples include lower premiums for sprinkling systems in fire insurance and no smoker discounts in life insurance.
- ▶ Insurers are also subject to moral hazard concerns.
  - ▶ For example, if they acquire a protected variable such as political affiliation, then they have to be careful that this knowledge does not implicitly bias their pricing processes even if they do not use this information actively.
  - ▶ A good way to mitigate this risk is to simply avoid acquiring such protected information.

Economic Efficiencies

- Economists largely agree that a competitive market is an efficient one

  - Efficiency is achieved because competition forces buyers to pay their maximum demand price and forces sellers to charge their minimum supply price

- Competition serves the best interests of consumers in that it provides insurers incentives to attract customers by reducing prices or improving insurance products

- Insurers classify risks to promote competition

  - Think of standard examples of "death spirals" that cause markets to collapse without risk classification.

- Rate regulation can limit the insurers ability to classify risks and hence threaten competition.

Price Discrimination in Economics

- ▶ Price discrimination is common in some industries.

    - ▶ For example, airlines regularly charge higher prices for flights during the week (e.g., Monday to Friday) because these are typically taken by business travelers.

- ▶ This is an example of so-called "first-degree price discrimination" where the price is based on the buyer's willingness to pay.

- ▶ Second-degree discrimination involves quantity discounts, whereas

- ▶ Third-degree discrimination reflects different prices for different consumer groups, e.g., senior citizens.

Price Discrimination in Insurance

- ▶ "Risk-based" price discrimination is the norm in insurance pricing.

- ▶ Thomas (2012) uses the phrase "non-risk price discrimination" for the insurance situation where prices may differ for the same coverage and underlying risk characteristics.

- ▶ First-degree price discrimination is common in large commercial insurance where it is assumed that buyers are sophisticated and willing and able to negotiate prices.

- ▶ Third-degree price discrimination is common in personal insurance, at least in Europe and the United Kingdom.

    - ▶ For example, renewals are often distinguished from risk-identical new customers, with different (usually lower) price offers made to new customers; "paying customers to switch."

Should the Insurance Marketplace Allow for Price Discrimination?

Thomas (2012) summarizes five aspects of insurance that makes it different from other marketplaces.

- ▶ Ability to discriminate. Insurers can differentiate prices because:
    - ▶ Insurers have high quality data; they gather much of it under the legal doctrine of utmost good faith.
    - ▶ Insurance pricing is difficult for consumers to understand.
    - ▶ Re-selling of an insurance contract is not common because it is specific to an individual.

- ▶ Price discrimination in insurance does not facilitate new markets.

- ▶ Price discrimination may undermine utmost good faith. Laws mandate that customers provide information about their risks truthfully.

- ▶ Non-risk based price discrimination may undermine justifications for risk-related pricing.

- ▶ Distributional effects of price discrimination.

Actuarial Aspects

Actuarial Pricing

- ▶ Prices based on insurance costs are sometimes known as **technical prices**. Insurance costs consist of:
  - ▶ losses,
  - ▶ expenses associated with the policy and claim, and
  - ▶ cost of capital (costs of keeping monies necessary to fund the insurance operation)

- ▶ Most rate regulations are based on technical prices.

- ▶ U.S. is the country that most actively regulates rates:
  - ▶ From the Casualty Actuarial Society, *a rate is reasonable and not excessive, inadequate, or unfairly discriminatory if it is an actuarially sound estimate of the expected value of all future costs associated with an individual risk transfer*.
  - ▶ From the model rating law NAIC (2010), *Rates shall not be excessive, inadequate or unfairly discriminatory.. It further defines an unfair discriminatory rate as . . .*
  - ▶ *Unfair discrimination exists if, after allowing for practical limitations, price differentials fail to reflect equitably the differences in expected losses and expenses*.

Extent of Regulation

- Insurance regulations may consist of applicable acts, statutes, regulations or any other binding authority (such as accounting standards and any regulatory guidance that is effectively binding),
    - See the the International Standards of Actuarial Practice (ISAPs) of the International Actuarial Association.
- The extent of insurance rate regulation varies by jurisdiction and by line of business.
    - At one end of the spectrum, the phrase *active rate regulation* means that the regulator is heavily involved in determining rates. This could mean government mandated rates in which regulators dictate the rates to be charged.
    - Alternatively, regulators may only require approval of rates, either in advance or concurrent with policy offerings.
    - The other end of spectrum is *competitive rating* or *open competition* systems. Borselli (2011) notes that historically many European countries operated under active rate regulatory environments but now regulators of European members states do not have the right to regulate insurance prices.

Lines of Business

Prohibitions by Line of Business

- ► Prohibitions vary greatly by line of business.
    - ► This is consistent with the survey conducted by Schmeiser et al. (2016) on consumers' opinions of the fairness of the resulting price differences; this survey demonstrated variation by jurisdiction and by line of business.

- ► The markets in which rate regulation is most common - medical malpractice, workers compensation, automobile, homeowners', and health insurance – are all markets in which insurance is mandatory or in which universal coverage is thought to be socially desirable, Tennyson (2007).
    - ► Commercial Insurance: Medical Liability, Workers' Compensation
    - ► Unisex Rating
    - ► General Insurance and Credit-Based Scoring
    - ► General Insurance and Price Optimization
    - ► Life Insurance and Genetic Testing
    - ► Big Data

Commercial Insurance

- ▶ In commercial lines of insurance such as general liability and professional liability, the policyholder is a firm.

  - ▶ Insurance rate regulation tends to be absent from commercial insurance.

  - ▶ Firms typically have more resources than individuals and so do not suffer the same imbalance of information asymmetry.

- ▶ Exceptions: medical malpractice and workers' compensation continue to be highly regulated.

  - ▶ Medical malpractice, also known as medical professional liability, is a type of insurance that provides compensation to injured patients and their families due to healthcare provider negligence.

  - ▶ Workers' compensation is a form of insurance purchased by employers that provide wage replacement and medical benefits to employees injured in the course of employment.

Unisex Rating

▶ Following a 2011 decision by the European Court of Justice, European insurers may no longer use gender for insurance purposes

  ▶ Prior to this ruling, gender was routinely used for pricing insurance.

  ▶ This was a big upheaval in the insurance world.

▶ In the U.S., gender is not permitted for pension plans

  ▶ From the case of ("Los Angeles Department of Water and Power Versus Manhart" 1978), employers cannot require women to make larger contributions to a pension plan in order to receive the same monthly benefits as similarly situated men.

  ▶ From the case of ("Arizona Governing Committee for Tax Deferred Annuity and Deferred Compensation Plans Versus Norris" 1983), women cannot receive lower monthly benefits than men who had made the same contributions.

▶ Gender-based pricing of auto insurance is permitted in all but a handful of U.S. states (the exceptions being Hawaii, Massachusetts, Montana, North Carolina, Pennsylvania, and, in 2019, California)

Why Limit Use of Gender?

▶ What characteristics of this trait would lead society to prohibit its use for insurance discrimination?

▶ Gender is certainly beyond the control of the insured and for the most part does not change over time.

▶ Insurers have economic motivation for using gender as a predictor because, for many lines of business, it exhibits helpful predictive abilities even though its causal attributes can be debated.

  ▶ Very important for pensions

  ▶ For other lines, e.g., auto, other variables provide a suitable substitute

▶ The most important motivation for prohibiting gender as a rating variable is to limit the perpetuation of negative stereotypes, so that men and women would receive equal treatment in the access to and supply of all goods and services.

General Insurance and Credit-Based Insurance Scoring

- ▶ Known since at least 1949 that credit history is related to driving accidents

- ▶ Became more routine with the development by Fair Isaac Corporation (FICO) scores in the mid 1990s, first for homeowners and then for auto.

- ▶ Credit-based insurance scores, or simply insurance scores, are similar to widely known credit scores in that both rely upon an individual's credit history.

- ▶ Credit history includes
    - ▶ prior credit performance (e.g., late payments),
    - ▶ current levels of indebtedness (e.g., bankruptcy),
    - ▶ length of credit history (e.g., age of oldest account, average age of all accounts),
    - ▶ pursuit of new credit (e.g., new accounts, mortgages), and
    - ▶ types of credit used (e.g., department, travel, major bank credit cards).

- ▶ Credit scores predict the risk of credit delinquency and so measures the financial well-being of a consumer.

- ▶ In contrast, an insurance score is designed to predict insurance losses and so assesses how well individuals manages their money.

Insurance Credit Scores as Proxy Variables

- ▶ Credit-based insurance scores provide a natural example where the ability to predict insurance losses is well established (statistical discrimination)

- ▶ The causal nature is uncertain

  - ▶ A poor credit score may not create (cause) an insured loss but it is a measure of underlying biological and psycho-behavioral traits that do affect insured losses (Brockett and Golden (2007)).

  - ▶ Two of the major drivers of credit risk are unemployment and health problems, neither of which seems to reflect irresponsible behavior such as reckless driving or lack of fire safety (Morris, Schwarcz, and Teitelbaum (2017)).

- ▶ Insurance scores are regulated because they potentially correlate with suspect classifications, in particular race and income.

- ▶ Most (U.S.) states regulate insurers' use of insurance scores in auto and home insurance, and a few states ban their use altogether

General Insurance and Price Optimization

▶ Technical prices, that are based on expected claims, provide the foundations

▶ Traditionally, informal judgement has been used to adjust technical prices to become market prices; these are adjustments (i) for consistency among factors, plans, and over time, (ii) for competitors rates, and (iii) for impact on retention

▶ *Price optimization* refers to a systematic approach for making adjustments to traditional cost-based technical prices that incorporates customer demand.

▶ Technical prices can be thought of as based on single-period models

▶ Price optimization approach incorporate models of retention as well as prices of competitors typically by looking over several periods.

  ▶ For example, if an insurer raises prices, then that insurer can expect lower retention; the amounts depend on how sensitive the consumer is to prices changes and the availability of the same coverage from the competition.

  ▶ By looking over several periods, price optimization models can tune prices to achieve an insurer's long-term goals, such as profitability or development of market share.

Price Optimization and Discriminatory Outcomes

- From an insurer's point of view, the use of price optimization tools is simply a sound business practice that is widely

- At the individual consumer level, it may be that an insurer prices differently two consumers with the same risk profile because their anticipated price sensitivity differs.

- Consumers have taken a dim viewpoint of price optimization

  - Critics argue that price sensitivity practices impose an unfair penalty on customer loyalty.

  - Customers more likely to be loyal are less likely to shop for alternatives.

  - Insurers will identify this tendency and so impose price increases on customers, not for their tendency to have high claims but rather for their tendency to be loyal.

- Many of those less likely to shop around for a better price are low-income and minority consumers.

- Thus, although insurers may be optimizing neutral objectives, the result of their actions may result in unintentional proxy discrimination.

- Swayed by these arguments, many U.S. insurance state regulators have banned price optimization in personal lines insurance.

Life Insurance and Genetic Testing

- ▶ Genetic testing is a type of medical test that examines chromosomes, genes, or proteins.

  - ▶ The results of a genetic test can confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on a genetic disorder.

  - ▶ There are many different purposes for testing, including medical (such as diagnosing a genetic disease or predicting disease risk) and non-medical (such as confirming parentage or forensic investigation).

- ▶ Currently, genetic information is in most cases neither statistically nor economically significant for risk assessment

  - ▶ The exceptions are the rare single-gene diseases, such as Huntington's disease, which inevitably or very likely result in death.

  - ▶ Insurers believe that predictive ability of genetic testing will increase over time and become salient in at least the life, disability, critical illness and long-term care insurance marketplaces.

Life Insurance and Genetic Testing

▶ Information from genetic tests is potentially sensitive because it is not under the control of an individual nor, in most cases, do they change over time

▶ Insurers worry about genetic testing information because of information asymmetry concerns. When a potential policyholder has information about his or her health that is not shared with the insurance company, adverse selection may arise.

▶ Some feel that genetic information should be treated with the same care as other types of medical information, e.g. blood pressure

▶ Empirical evidence shows that fear of genetic discrimination has led individuals across the globe to refuse to participate in genetic research projects or to fail to undergo recommended clinical testing.

Genetic Testing Prohibitions by Country

Regulation Category	Country
No regulation	China, Finland, India, Spain, United States
No regulation with written or unwritten codes of conduct from insurance industry groups	Greece, Japan
Prohibitions on insurers requiring applicants to take a genetic test and prohibitions on discrimination if the applicant refuses to take a test	Australia*
Prohibitions on using results from existing tests when policies are below certain limits	Germany, Netherlands, Switzerland, United Kingdom
Prohibitions on using results from existing tests at all, sometimes including use of family history information	Austria, Belgium, Canada, Denmark, France, Ireland, Poland, Portugal, Singapore

Source: Klein (2017)

Big Data in Insurance

Analytics is now being used in almost every facet of insurance operations including not only marketing of products but also pricing, underwriting, claims management, and reserving.

Data Sources	Algorithms
Mobile devices	Statistical learning
Auto telematics	Artificial intelligence
Home sensors	Structural models
(Internet of Things)	
Drones, micro satellites	

Data	Software
Big data	Text analysis, semantics
(text, speech, image, video)	
Behavioral data	Voice recognition
(including social media)	
Credit, trading, financial data	Image recognition
	Video recognition

Big Data

- ▶ Conceptually, Big Data does not alter the fundamental issues of insurance discrimination, c.f., entitled "Risk Classification's Big Data (R)evolution," Swedloff (2014)

    - ▶ One can think of credit-based scoring and price optimization as simply forerunners of a long-term trend by insurers to gather more and more data about their current and potential customers.

- ▶ One might hope that machine-driven algorithms would eliminate human biases but these algorithms inherit the prejudices of authors of the algorithms and prior decision-makers, Barocas and Selbst (2016).

- ▶ The two main aspects of change are **privacy** and **proxy discrimination**.

Big Data Privacy

- Some information is provided voluntarily by individuals to insurers

    - This includes information from global position systems (GPS) that we put in our cars that underpin telematics, comparable devices for our homes (the Internet of Things), devices that we wear to improve our health, and so forth.

- Insurers also use information that is not provided directly by individuals.

    - Privacy issues are raised any time a carrier classifies risks on intimate, personal information, like HIV status, marital status, sexual orientation, or genetic information.

- Target Example (2012)

    - Target, a large U.S. department store, used analytics to predict which of its customers were pregnant.

    - This information was passed on to the marketing arm who sent coupons for maternity clothing, nursery furniture, and the like, to women who were likely to be expecting a child.

    - Without asking any customers about their pregnancy status or harvesting that data in particular, Target was able to predict extremely sensitive and personal information about its customers.

    - Consumer advocates fear that other information, such as where we go, movies that we watch, telephone calls and texts that we make, could also readily be used for understanding consumers attitudes towards risk and the likelihood of making insurance claims.

Big Data Proxy Discrimination

▶ Proxy discrimination occurs when a surrogate, or proxy, is used in place of a prohibited trait.

▶ As originally conceived, this proxy is a facially neutral trait, such as the size of an automobile's engine (being used as a proxy for gender).

▶ In the world of Big Data, an equally important issue is that complex algorithms are being developed using literally thousands of traits

  ▶ In the simple Target example, the analyst used only 25 traits to develop an effective pregnancy score.

▶ Proxy discrimination may be unintentional; moreover, the insurer may not even be aware that it is engaging in discriminatory behavior due to the opaqueness of machine-driven algorithms.

▶ Although consumers may benefit from a marketplace where insurers can more accurately assess risks, there is also a potential loss of **transparency** in insurance pricing.

  ▶ There already exists a low level of consumer understanding and a low level of consumer engagement with insurance purchases.

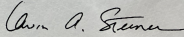 ▶ More complex data algorithms will impede efforts at transparency.

Case Study: COVID-19

Introduction to COVID-19

- A pandemic is a global outbreak of disease

- The new coronavirus dubbed COVID-19, short-hand with the 'CO' for 'corona,' 'VI' for 'virus,' and 'D' for disease. The '19' is because it was first identified in 2019 (in Wuhan China).

- As with other parts of global economy, the disease has rocked the insurance industry.

- The lines of business most affected include:
  - commercial side – workers' compensation, business interruption insurance, cyber liability, general liability, event cancellation
  - personal side – health and travel insurance

- Interestingly, automobile insurance claims have dramatically reduced due to travel restrictions; people are driving less and getting into fewer accidents.

Refund Check from Auto Insurer

Check dated 14 April 2020 as a refund for COVID-19 ...

Prohibiting Coverage Discrimination Based on COVID-19 Diagnosis

- ▶ Insurance legislation is being introduced to prohibit discrimination based on the diagnosis of this disease.

- ▶ For example, the State of Wisconsin passed a law on 15 April 2020 that includes the following:

  - ▶ This bill prohibits insurers that offer an individual or group health benefit plan, pharmacy benefit managers, or self-insured governmental health plans from doing any of the following based on a current or past diagnosis or **suspected** diagnosis of COVID-19: (emphasis added)

    - ▶ establishing rules for the eligibility of any individual, employer, or group to enroll or remain enrolled in a plan or for the renewal of coverage under the plan;

    - ▶ cancelling coverage during a contract term;

    - ▶ setting rates for coverage;

    - ▶ or refusing to grant a grace period for payment of a premium that would generally be granted.

- ▶ It is likely that other legal jurisdictions will undertake similar actions.

Wisconsin COVID-19 Prohibitions

- ▶ This legislation has several implications.

    - ▶ For example, in absence of this legal restriction, rates may well increase for grocery store workers, due to their exposure and increased **suspicion** of a diagnosis of COVID-19.

    - ▶ Is this in the best interest of society?

- ▶ (Narrow) Actuarial perspective

    - ▶ This legislation is about coverage and rating and so is important for actuaries.

    - ▶ In absence of legal restrictions, a competitive market would use diagnosis of COVID-19 like any other part of medical history, potentially predictive of future insurable events.

- ▶ To sharpen understanding of the social and economic principles, we now reflect on these principles in terms of COVID-19.

Social Considerations of Wisconsin COVID-19 Prohibitions

- ▶ A pandemic brings out the "social responsibility" of an insurance pool

- ▶ Insurance may be viewed as social/public good or as an economic commodity but the responses to COVID-19 are certainly social;

  - ▶ when you build a dam it benefits everyone who lives in the area not just those who make contributions towards building it.

- ▶ *Proxy Discrimination.* In the U.S., it is known that COVID-19 affects African-Americans more than other ethnic groups and that COVID-19 mortality rates are related to age.

  - ▶ Insurer discrimination based on contracting COVID-19 could be viewed as an indirect path to race and, where pertinent, age discrimination.

- ▶ Next, consider variable attributes that influence fairness for insurance purposes

Fairness Characteristics of COVID-19 Diagnosis

- Variable attributes that influence fairness for insurance purposes:

    - *Control*. Individuals have few controls as to whether they are diagnosed with the disease.

    - *Mutability*. The variable may change over time but not in a good way.

    - *Causality/Statistical Discrimination*. For those that have recently contracted the disease, there is a known pathway to heightened mortality risk and healthcare costs. For those diagnosed with disease but have recovered, there are no known additional risks to mortality nor to morbidity.

    - *Limiting or Reversing the Effects of Past Discrimination*. Not an issue as this is a new disease.

    - **Inhibiting Socially Valuable Behavior**. If insurers were allowed to rate based on disease symptoms, it is likely that many would refuse testing which would inhibit scientific progress in addressing the disease, similar to genetic testing.

Economic Considerations of Wisconsin COVID-19 Prohibitions

- *Adverse Selection.* It is likely that individuals would know about whether they had symptoms of COVID-19 without going through formal testing - unknown to the insurer.

  - This creates the potential for adverse selection.

- *Competition.* It is unlikely that any insurer will have private knowledge about the nature of the COVID-19 disease suggesting that marketplace competition is not an issue.

  - However, some insurers may elect to pull out of the marketplace (such as with travel insurance), meaning that lack of supply may increase prices.

- *Price discrimination* is not likely to be an issue with COVID-19.

Summary of Wisconsin COVID-19 Prohibitions

► For a pandemic, the weight of evidence suggests that **societal concerns dominate** and that a prohibition based on diagnosis, real or suspected, of COVID-19 is warranted.

► As insurers' lack data about its predictive abilities, it is unlikely that competition will be affected.

► Prohibitions of this nature increase consumer confidence in the insurance system.

► At a hopefully not too far date in the future, the COVID-19 will lose its pandemic status and become another disease that we have to deal with. At that time, special legislative actions for COVID-19 will lose their appeal.

Jurisdiction: Australia

Australia

- Australia has anti-discrimination legislation at the federal, state and territory levels. Commonwealth laws and the state/territory laws generally overlap and prohibit the same type of discrimination.

- There are four federal acts containing provisions relevant to discrimination in insurance, the Age Discrimination Act 2004 (ADA), the Sex Discrimination Act 1984 (Cth)(SDA), the Racial Discrimination Act 1975 (Cth)(RDA) and the Disability Discrimination Act 1992 (Cth)(DDA).

- Each state and territory in Australia has its own anti-discrimination acts with its own insurance exceptions.

Example: Compulsory Third Party (CTP) insurance

▶ ACT's CTP insurance scheme is a 'community rated' scheme, with all motorists for each vehicle class pay the same amount regardless of their individual risk profile.

▶ The Victorian CTP insurance scheme allows the use of three factors to determine the premium, which are the vehicle classification (vehicle type and use), postcode, and eligibility for a pensioner discount.

▶ The New South Wales? CTP insurance is the least regulated compared with the other states and territories. It allows the use of more factors for pricing, including for example geographic region, type of vehicle, age of vehicle, distance traveled and Vehicle performance and else.

Proxy Discrimination

Proxy Discrimination

- ▶ Proxy discrimination is when a seemingly innocuous variable is correlated with a protected variable

  - ▶ Can be a problem because it produces the same outcomes that would be obtained in the absence of restrictions based on directly predictive traits

  - ▶ True whether or not the surrogate is opaque to the insurer and the regulator.

Strategies for Mitigating Proxy Discrimination

1. **Community Rating.**

2. **Approved Variables**. Another option is to specify variables that may be used instead of variables that may not be used.
   - ► Example: U.S. individual health insurance market under the Affordable Care Act (ACA). Specifically, insurers may vary rates based on only four factors, (1) whether a plan covers an individual or family, (2) geographic area, (3) age, and (4) smoking status.

3. **Actuarial Justification**. A third alternative is to restrict the use of protected variables and to further limit the use of rating variables to only those that are actuarially justified.
   - ► Example: U.S. rules on unfair discrimination where variables induce price differentials that "reflect equitably the differences in expected losses and expenses."

4. **Limited Prohibitions**. A fourth strategy is to only restrict the use of selected variables such as gender.
   - ► Example: European Union. European regulation permit the use of risk factors correlated with gender as long as they are risk factors in their own right.

5. **No Restrictions**. At the other end of the spectrum, an option is to have no prohibitions.
   - ► Example: Commercial insurance

.

Empirical Example

- ▶ Data: 4624 claims from Australian automobile insurance drawn from De Jong and Heller (2008).

- ▶ y: claims severity, `ClaimAmount`

- ▶ X_P: potentially contentious or protected variable, an indicator for gender, `Female`

- ▶ X_{NP}: non-protected variables (permitted)

  - ▶ `VehValue`: the vehicle value ($000)
  - ▶ `DrivAge`: the age and employment status of the policyholder

    - ▶ `DrivAge.old people`
    - ▶ `DrivAge.older work people`
    - ▶ `DrivAge.oldest people`
    - ▶ `DrivAge.working people`
    - ▶ `DrivAge.young people`

- ▶ Model: Gamma regression with log link

Linear Model Strategies

▶ Model 1: A "full" linear regression model without regulation

$$\hat{y}_{full} = \mathbf{1}\, b_0 + X_P\, b_1 + X_{NP}\, b_2. \tag{1}$$

▶ Model 2: A restricted model excluding the protected variable (i.e. `Gender`)

$$\hat{y}_{restricted} = \mathbf{1}\, b_{0,1} + X_{NP}\, b_{2,1}. \tag{2}$$

▶ Model 3: A restricted model that use predictors uncorrelated with the sensitive, protected, variables

$$\hat{y}_{FH} = \mathbf{1}\, \bar{y} + X_{NP}^{\star}\, b_2. \tag{3}$$

▶ Model 4: Adding the proxy predictor for `Female` to model 2

▶ Model 5: Adding the proxy predictor for `Female` to model 3

▶ Model 6: Pope and Sydnor (2011)

$$\hat{y}_{PS} = \mathbf{1}\, b_0 + \bar{X}_P\, b_1 + X_{NP}\, b_2, \tag{4}$$
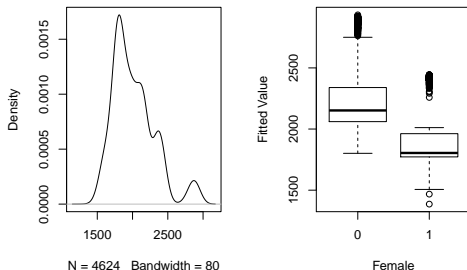
Distribution of Claim Amounts

Figure: Distribution of Claim Amounts

The right-hand panel of Figure 1 shows significant differences by gender.

Table: Gamma Regression Model Summary

	M.1 Coef	M.1 t	M.2 Coef	M.2 t	M.3 Coef	M.3 t	M.4 Coef	M.4 t	M.5 Coef	M.5 t
(Intercept)	7.98	85.58	7.88	89.45	7.61	156.37	8.16	50.19	7.89	54.92
VehValue	-0.01	-0.52	0.00	-0.13	0.00	-0.14	-0.02	-0.88	-0.02	-0.91
DrivAge.old people	-0.41	-3.95	-0.42	-4.01	-0.43	-4.06	-0.45	-4.22	-0.45	-4.26
DrivAge.older work people	-0.29	-3.13	-0.31	-3.24	-0.30	-3.19	-0.30	-3.18	-0.30	-3.14
DrivAge.oldest people	-0.35	-2.97	-0.34	-2.85	-0.35	-2.93	-0.38	-3.13	-0.39	-3.21
DrivAge.working people	-0.29	-3.14	-0.32	-3.39	-0.31	-3.27	-0.30	-3.21	-0.29	-3.11
DrivAge.young people	-0.20	-2.07	-0.21	-2.20	-0.21	-2.16	-0.22	-2.25	-0.21	-2.22
Female	-0.18	-3.45	NA	NA	NA	NA	-0.42	-2.08	-0.43	-2.12
AIC	79365.63	NA	79391.08	NA	79390.49	NA	79382.40	NA	79381.38	NA

Table: Comparison of Means by Predictors and Gender

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Male	2215.56	2012.62	2014.18	2046.90	2051.63	2034.42
Female	1863.01	2015.88	2014.61	1990.49	1986.86	2045.10

▶ Model 2 does not require information about the protected variable, `Female`.

▶ Model 3 is attractive because it only uses predictors that are uncorrelated with the protected variable Female.
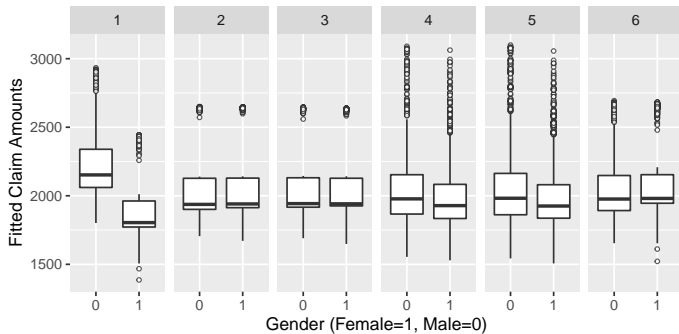
Figure: Boxplots of Fitted Claim Amounts by Model and Gender

Machine Learning Approaches

- ▶ Insurance/actuarial related literature

    - ▶ Pope and Sydnor (2011)

    - ▶ Lindholm et al. (2020)

- ▶ Fairness Machine Learning (Kleinberg, Mullainathan, and Raghavan, 2016)

- ▶ Discrimination Discovery

- ▶ Discrimination Prevention

    - ▶ Data Pre-processing

    - ▶ Model Regularization

    - ▶ Model Post-processing

- ▶ Mitigating discrimination without collecting sensitive data (Veale and Binns, 2017)